

76. (New) The integrated-circuit assembly of claim 72, wherein the metal consist essentially of copper.

REMARKS

As a result of this amendment, claims 38-76 are now pending in this application. Of these, claim 38 stands rejections under §102(b).

Response to §102 Rejection

Claim 38 was rejected under 35 USC §102(b) as anticipated by Muraoka (JP 405267643A).

However, applicant submits that claim 38 has been amended to more readily distinguish from Muraoka.

Specifically, amended 38 now recites that “the second diffusion barrier comprises a zinc oxide material and the first diffusion barrier comprising a material different than the zinc oxide material.” Thus, claim 38 requires at least two barriers that comprise different materials.

In contrast, Muraoka, as represented in its abstract, shows only barrier metal 8 that consists of an oxide conductor, such as ZnO. No other barrier or barrier material in combination with the zinc oxide appears to be shown.

Accordingly, applicant respectfully requests reconsideration and withdrawal of the §102 rejection.

Information Disclosure Statement

Applicant respectfully requests that signed copies of the 1449 Forms, acknowledging consideration of the references submitted with the Information Disclosure Statements filed on March 26, 2001 and May 16, 2001, be returned with the next official communication. An additional Information Disclosure Statement and 1449 Form accompanies this amendment, and similar consideration and acknowledgment is also requested.

FEB 12 2002

Conclusion

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In view of the amended application and remarks, applicant respectfully requests reconsideration of the application. Further, applicant invites the Examiner to telephone its patent counsel Eduardo Drake at 612- 349-9593 to resolve any issues which might delay allowance.

If necessary, please charge any additional fees or credit overpayment to Deposit Account No. 19-0743.

Respectfully submitted,

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23 Jan 2002

By

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CERTIFICATE UNDER 37 CFR 1.8: The undersigned hereby certifies that this correspondence is being deposited with the United States Postal Service with sufficient postage as first class mail, in an envelope addressed to: Commissioner of Patents, Washington, D.C. 20231, on this 23rd day of January, 2002.

Name

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Docket No. 303.450 S2
WD #408238

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Micron Ref. No. 97-0853.01

Clean Version of Pending Claims

METHODS FOR MAKING COPPER AND OTHER METAL INTERCONNECTIONS IN
INTEGRATED CIRCUITS
Applicant: Kie Y. Ahn et al.
Serial No.: 09/817,447

Claims 38-76, as of January 23, 2002 (date of response to first office action filed).

B1 38. (Amended) An integrated-circuit assembly comprising:
an insulative layer having a trench or hole, the trench or hole having an edge;
a first diffusion barrier having a portion inside the trench or hole; and
a second diffusion barrier on the insulative layer and having an edge substantially
flush with a least a portion of the edge of the trench or hole, with the
second diffusion barrier comprising a zinc oxide material and the first
diffusion barrier comprising a material different than the zinc oxide
material.

B2 Contd 39. (New) The integrated-circuit assembly of claim 38:
wherein the assembly further comprises a metal within the trench or hole; and
wherein the first diffusion barrier has a first wettability with the metal and the
second diffusion barrier has a second wettability with the metal, the first
wettability greater than the second wettability.

40. (New) The integrated-circuit assembly of claim 38, further comprising a copper structure
within the trench or hole.

41. (New) The integrated-circuit assembly of claim 38, wherein the first diffusion barrier
consists essentially of tungsten, titanium-tungsten, or titanium nitride.

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42. (New) The integrated-circuit assembly of claim 38, wherein the second diffusion barrier has no substantial portion within the trench or hole.
43. (New) The integrated-circuit assembly of claim 38, wherein the trench or hole has an outer perimeter and wherein the second diffusion barrier includes a portion extending over the outer perimeter of the trench or hole.
44. (New) The integrated-circuit assembly of claim 38, wherein the portion of the first diffusion barrier conforms to walls and a floor of the trench or hole.
45. (New) The integrated-circuit assembly of claim 38, wherein the insulative layer consists essentially of a silicon oxide.
46. (New) An integrated-circuit assembly comprising:
an insulative layer having a trench or hole, the trench or hole having an edge;
a first diffusion barrier lining the trench or hole;
a second diffusion barrier on the insulative layer and having an edge substantially flush with a least a portion of the edge of the trench or hole, with the second diffusion barrier comprising a zinc oxide material;
a copper conductor within the trench or hole and on the first diffusion barrier, with the second diffusion barrier having lesser wettability with copper than the zinc oxide material.
47. (New) The integrated-circuit assembly of claim 46, wherein the second diffusion barrier has no substantial portion within the trench or hole.

PENDING CLAIMS

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Docket No. 303.459US2

Micron Ref. No. 97-0853.01

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48. (New) The integrated-circuit assembly of claim 46, wherein the insulative layer consists essentially of a silicon oxide.
49. (New) The integrated-circuit assembly of claim 46, wherein the first diffusion barrier consists essentially of tungsten.
50. (New) The integrated-circuit assembly of claim 46, wherein the first diffusion barrier consists essentially of titanium-tungsten.
51. (New) The integrated-circuit assembly of claim 46, wherein the first diffusion barrier consists essentially of titanium nitride.
52. (New) An integrated-circuit assembly comprising:
an insulative layer having a trench or hole, the trench or hole having an edge;
a first diffusion barrier lining the trench or hole, the first diffusion barrier
consisting essentially of tungsten, titanium-tungsten, or titanium nitride;
a second diffusion barrier on the insulative layer and having an edge substantially
flush with a least a portion of the edge of the trench or hole;
a copper conductor within the trench or hole and on the first diffusion barrier,
with the second diffusion barrier having lesser wettability with copper
than the zinc oxide material.
53. (New) The integrated-circuit assembly of claim 52, wherein the second diffusion barrier consists essentially of zinc oxide.
54. (New) The integrated-circuit assembly of claim 52, wherein the second diffusion barrier has no substantial portion within the trench or hole.

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55. (New) The integrated-circuit assembly of claim 52, wherein the insulative layer consists essentially of a silicon oxide.
56. (New) An integrated-circuit assembly comprising:
an insulative layer having opposing first and second major surfaces and a trench or hole in the first major surface;
a first diffusion-barrier layer having an in-portion within the trench or hole and an out-portion outside the trench or hole and on the first major surface; and
a second diffusion-barrier layer on the out-portion of the first diffusion-barrier layer, the second diffusion-barrier layer having no substantial portion within the trench or hole.
57. (New) The integrated-circuit assembly of claim 56, wherein the trench or hole has an outer perimeter at the first major surface and wherein the second diffusion-barrier layer includes a portion extending over the outer perimeter of the trench or hole.
58. (New) The integrated-circuit assembly of claim 56, wherein the first diffusion-barrier layer has a first wettability with a metal and the second diffusion-barrier layer has a second wettability with the metal, the first wettability greater than the second wettability.
59. (New) The integrated-circuit assembly of claim 56, wherein the first diffusion-barrier layer consists essentially of a material having a first wettability with a metal, and the second diffusion-barrier layer consists essentially of a material having a second wettability with the metal, with the first wettability greater than the second wettability.

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60. (New) The integrated-circuit assembly of claim 56, wherein the first diffusion-barrier layer consists essentially of a zinc oxide material and the second diffusion barrier consists essentially of tungsten, titanium-tungsten, or titanium nitride.
61. (New) The integrated-circuit assembly of claim 56, wherein the first diffusion-barrier layer consists essentially of a zinc oxide material.
62. (New) The integrated-circuit assembly of claim 56, wherein the second diffusion barrier consists essentially of tungsten, titanium-tungsten, or titanium nitride.
63. (New) The integrated-circuit assembly of claim 56, further comprising a copper structure within the trench or hole.
64. (New) The integrated-circuit assembly of claim 56, wherein the insulative layer consists essentially of a silicon oxide.
65. (New) The integrated-circuit assembly of claim 56, wherein the in-portion of the first diffusion-barrier layer conforms to walls and a floor of the trench or hole.
66. (New) An integrated-circuit assembly comprising:
a silicon oxide insulative layer having opposing first and second major surfaces
and a trench or hole in the first major surface;
a first diffusion-barrier layer having an in-portion within the trench or hole and an
out-portion outside the trench or hole and on the first major surface;
a second diffusion-barrier layer on the out-portion of the first diffusion-barrier
layer, the second diffusion-barrier layer having no substantial portion
within the trench or hole; and

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a copper conductor at least partially within the trench or hole and on the first diffusion-barrier layer.

67. (New) The integrated-circuit assembly of claim 66, wherein the in-portion of the first diffusion-barrier layer conforms to walls and a floor of the trench or hole.
68. (New) An integrated-circuit assembly comprising:
an insulative layer having opposing first and second major surfaces and a trench or hole in the first major surface;
a first diffusion-barrier layer having an in-portion within the trench or hole and an out-portion outside the trench or hole and on the first major surface, the in-portion of the first diffusion-barrier layer conforming to walls and a floor of the trench or hole;
a second diffusion-barrier layer on the out-portion of the first diffusion-barrier layer, the second diffusion-barrier layer having no substantial portion within the trench or hole; and
a copper conductor at least partially within the trench or hole and on the first diffusion-barrier layer.
69. (New) The integrated-circuit assembly of claim 68, wherein the insulative layer consists essentially of silicon oxide.
70. (New) An integrated-circuit assembly comprising:
an insulative layer having opposing first and second major surfaces and a trench or hole in the first major surface, with the trench or hole having an outer perimeter;
a first diffusion-barrier layer having an in-portion within the trench or hole and an

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out-portion outside the trench or hole and on the first major surface, the in-portion of the first diffusion-barrier layer conforming to walls and a floor of the trench or hole;

a second diffusion-barrier layer on the out-portion of the first diffusion-barrier layer, the second diffusion-barrier layer having no substantial portion within the trench or hole and having a portion extending over the outer perimeter of the trench or hole; and

a copper conductor at least partially within the trench or hole and on the first diffusion-barrier layer.

71. (New) The integrated-circuit assembly of claim 70, wherein the insulative layer consists essentially of silicon oxide.
72. (New) An integrated-circuit assembly comprising:
- an insulative layer having opposing first and second major surfaces and a trench or hole in the first major surface, with the trench or hole having an outer perimeter;
 - a first diffusion-barrier layer having an in-portion within the trench or hole and an out-portion outside the trench or hole and on the first major surface and consisting essentially of a material having a first wettability with a metal, with the in-portion of the first diffusion-barrier layer conforming to walls and a floor of the trench or hole;
 - a second diffusion-barrier layer contacting the out-portion of the first diffusion-barrier layer, consisting essentially of a material having a second wettability with the metal, having no substantial portion within the trench or hole, and having a portion extending over the outer perimeter of the trench or hole, with the second wettability less than the first wettability;

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and

a conductor consisting essentially of the metal and being at least partially within the trench or hole and on the first diffusion-barrier layer.

73. (New) The integrated-circuit assembly of claim 72, wherein the insulative layer consists essentially of silicon oxide.
74. (New) The integrated-circuit assembly of claim 72, wherein the first diffusion-barrier layer consists essentially of a zinc oxide material and the second diffusion barrier consists essentially of tungsten, titanium-tungsten, or titanium nitride.
75. (New) The integrated-circuit assembly of claim 72, wherein the first diffusion-barrier layer consists essentially of a zinc oxide material.
76. (New) The integrated-circuit assembly of claim 72, wherein the metal consist essentially of copper.
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